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Circular No. 921

June 1953 • Washington, D. C.

UNITED STATES DEPARTMENT OF AGRICULTURE

The Test Weight Per Bushel of Grain: Methods of Use and Calibration of the Apparatus[1]

Prepared by the Grain Branch, Production and Marketing Administration

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TEST WEIGHT PER BUSHEL

The test weight per bushel is an important factor in assigning a grade to a lot of grain under the official grain standards of the United States. It is therefore essential that the test weight per bushel be accurately determined, as it affects the market value of the grain.

Test weight per bushel should not be confused with legal weight per bushel as these two terms have fundamentally different meanings. Test weight per bushel is the weight of the volume of grain required to fill level full a Winchester bushel measure of 2,150.42 cubic inches capacity. Legal weight per bushel is the number of pounds of grain required for a bushel without regard to volume and is the basis on which grain is usually bought and sold. For customs purposes[2] the legal weight per bushel has been fixed by Federal law in the

[1] This circular supersedes Department Bulletin No. 1065, "The Test Weight of Grain: A Simple Method of Determining the Accuracy of the Testing Apparatus," issued May 1922.

[2] Legal Weights per Bushel for Various Commodities. U. S. Dept. Commerce, National Bureau of Standards Cir. 425. 12 pp. 1940.

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United States at 60 pounds for wheat; 56 pounds for corn, rye, and flaxseed; 48 pounds for barley; and 32 pounds for oats.

The standard Winchester bushel measure contains 32 quarts, whereas the actual volume in quarts of a bushel of grain of legal weight depends upon its test weight. The volume in quarts required for a bushel of legal weight may be determined by multiplying the legal weight per bushel by 32 and dividing that product by the test weight per bushel of the grain in question. For example, the legal weight of wheat being 60 pounds for a bushel and the test weight of the wheat in question being 50 pounds, how many quarts will be required to weigh 60 pounds? Solution: Multiply 60 by 32 and divide by 50, as follows: $60 \times 32 = 1920 \div 50 = 38.4$ quarts, the volume required to weigh 60 pounds or a legal bushel of wheat for commercial purposes. Figure 1 shows graphically the number of quarts of grain for various test weights required to weigh the number of pounds for a legal bushel for various grains.

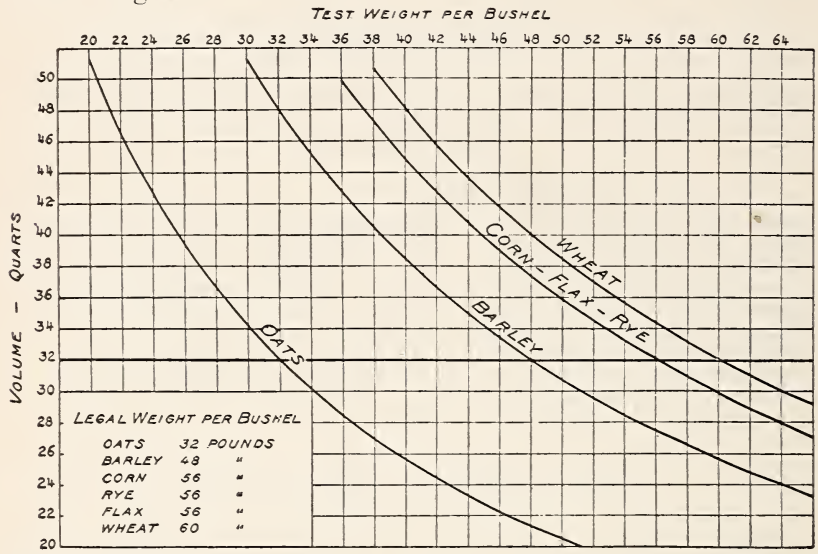
TEST WEIGHT PER BUSHEL
20 22 24 26 28 30 32 34 36 38 40 42 44 46 48 50 52 54 56 58 60 62 64
VOLUME - QUARTS
50 48 46 44 42 40 38 36 34 32 30 28 26 24 22 20
OATS
BARLEY
CORN - FLAX - RYE
WHEAT
LEGAL WEIGHT PER BUSHEL
OATS 32 POUNDS
BARLEY 48 "
CORN 56 "
RYE 56 "
FLAX 56 "
WHEAT 60 "

FIGURE 1.—The number of quarts, by measure, of grain of various test weights required for a "legal bushel" by weight.

APPARATUS FOR DETERMINING TEST WEIGHT PER BUSHEL

The weight-per-bushel tester (fig. 2) was designed by the United States Department of Agriculture to provide a rapid and accurate method for determining the test weight per bushel of the various grains.

The apparatus consists of a stand, filling hopper, test kettle, weighing beam, overflow pan, and stroker.

The standard weight-per-bushel tester is so designed that when the test kettle is properly filled and the surplus grain is struck off, it contains exactly 1 dry quart, or 67.2 cubic inches. When the filled test kettle is hung on the hook on the short end of the beam of the official

FIGURE 2.—Standard apparatus for determining the test weight per bushel of grain.

testing apparatus, the weight of its contents may be determined directly in terms of pounds per bushel by means of the counterpoise and the graduations on the beam. As there are 32 quarts to the bushel, the beam is graduated to indicate 32 times the actual weight of the contents of the test kettle; therefore, 1 pound in the kettle is equivalent to 32 pounds per bushel on the beam, 1 ounce to 2 pounds, 1/2 ounce to 1 pound, etc. When these facts are borne in mind the necessity for great care in following the prescribed method in making the weight-per-bushel test and for having an accurate kettle and beam will be realized.

STANDARD METHOD OF DETERMINING TEST WEIGHT PER BUSHEL

The following procedure has been found to be accurate in making weight-per-bushel tests and has been adopted as the standard method in the determination of test weight per bushel:

1. Make the test immediately after the sample has been brought to the laboratory, to prevent drying out of the grain with consequent change in its test weight per bushel. (See fig. 3.)
2. Use 1⅛ quarts of grain for making the test.
3. Fill the kettle from the hopper.
4. Make sure that—
   (*a*) Opening at bottom of hopper is round and 1¼ inches in diameter.
   (*b*) Bottom of opening in the hopper is centered over the kettle and is exactly 2 inches above the top of kettle.
   (*c*) The quart kettle has a capacity of exactly 67.2 cubic inches and the inside height of the quart kettle is 4 inches.
5. If the top of the kettle is rough, smooth down the roughness with a rounded metal bar, but do not use a file for the purpose.
6. Do not jar the kettle before or during the stroking operation.
7. Use a stroker made of hardwood and that has smooth, half-round edges, 12 inches long, 3/8 inch thick, and 1¾ inches wide.
8. Place the stroker on the edge of the kettle lightly without jarring the kettle.
9. Hold the stroker on the kettle so that the sides of the stroker are in a vertical position.
10. Stroke the grain from the kettle with three full-length zigzag motions of the stroker, each stroke covering one-third the distance across the top of the test kettle and the stroker always lightly touching the kettle.
11. Use a beam which is both accurately graduated and sensitive to one-tenth pound per bushel.
12. Have the weight-per-bushel apparatus tested periodically for—
   (*a*) Accuracy of kettle capacity,
   (*b*) Accuracy of beam readings, and
   (*c*) Sensitiveness of balance.

FACTORS THAT WILL CAUSE VARIATIONS IN TEST WEIGHT PER BUSHEL

Errors in the test weight per bushel may result from any of the following variations:

1. A weight beam that is inaccurate, insensitive, or "slow."
2. A kettle that is dented, bent, worn, or of a size other than the standard 1 quart capacity.
3. A kettle having rough edges, which is jarred by the stroker when the excess grain is stroked off, thus causing the grain to settle.
4. Filling the kettle by pulling it through the grain, pulling the grain over the edge by hand, or pouring the grain from the hand, pan, bag, or nonstandard hopper.
5. Pouring the grain into the kettle from a height or at a rate that does not conform with the recommendations.
6. Striking off the excess grain except in the regular manner and with the standard stroker.
7. Jarring or tapping the kettle before the excess grain is stroked off.

8. Pressing the grain into the kettle before the excess grain is stroked off.

9. Holding the stroker either slanted forward or backward instead of vertically while the excess grain is stroked from the test kettle.

10. Making the test on the original sample when it should have been made on the dockage-free sample.

Allowing samples, especially those having a high moisture content, to lie around and dry out for some time will also seriously affect their test weight per bushel (fig. 3).

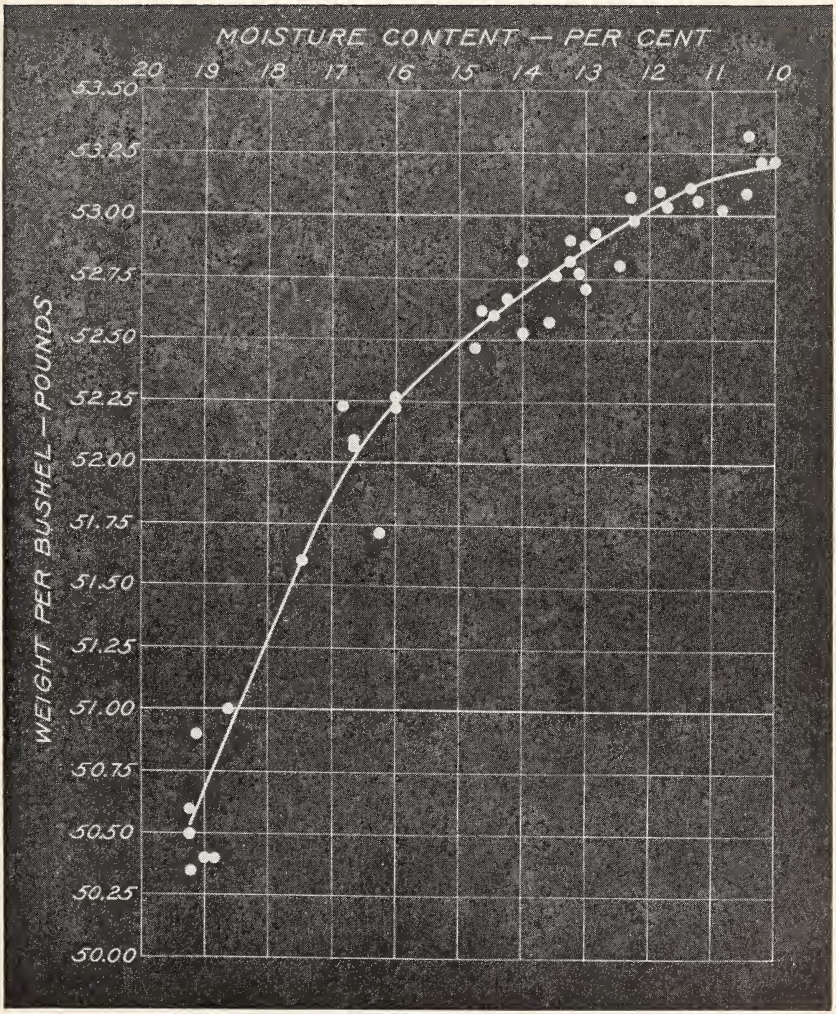

FIGURE 3.—The influence of moisture content on the test weight per bushel of corn. This illustrates the necessity of making the weight-per-bushel test immediately after the samples have been delivered to the inspection or testing room.

TABLE 1.—*Variations in the test weight per bushel of oats obtained by filling the test kettle by different methods*

Method of filling test kettle	Weight per bushel obtained							
	Individual tests					Minimum	Maximum	Average
	No. 1	No. 2	No. 3	No. 4	No. 5			
	Pounds	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*	*Pounds*
From a bag held 2 to 3 inches above the kettle	37	37. 5	37. 5	38. 25	37	37	38. 25	37. 45
By sinking it into the grain and pulling the grain into the kettle by hand:								
(1) By 1 motion of both hands	36. 5	36. 5	36. 5	36. 5	36. 25	36. 25	36. 5	36. 45
(2) By 9 to 11 motions of both hands	37	37	37	36. 75	37	36. 75	37	36. 95
By dipping it into the grain	38. 75	39. 25	39	39. 5	39. 5	38. 75	39. 5	39. 20
By pulling it through the grain with about a 2-foot sweep:								
(1) Through loose, worked-over grain	38	38. 25	38. 25	38. 25	39. 5	38	39. 5	38. 45
(2) Through the packed surface of the grain in a car before the grain had been worked over	39. 75	40. 75	39. 5	39	39. 75	39	40. 75	39. 75
From a hopper having an outlet opening 1¼ inches in diameter held 2 inches above the kettle (official method)	37. 2	37. 2	37. 3	37. 2	37. 2	37. 2	37. 3	37. 22

Any variation from the standard apparatus or the standard method of making the test may, and often does, result in an inaccurate test weight per bushel.

Table 1 shows the variations that can be obtained by different methods of filling the test kettle and figure 3 shows the variations that may be caused by changes in moisture content.

TESTING ACCURACY OF APPARATUS

The two steps in testing the accuracy of the weight-per-bushel tester are: (1) Determining the accuracy of the test kettle, and (2) determining the accuracy of the beam and the sensitiveness of the balance.

Method of Determining Accuracy of Test Kettle

The following apparatus is required to test the accuracy of the test kettle: A piece of plate glass 5 inches in diameter; a correct even-arm balance; 1 standard weight of 1,098.08 grams or a set of weights from which this amount can be made; a 1-gram weight (to determine tolerance); a supply of distilled water; and an accurate thermometer reading 20° C., or 68° F. (fig. 4).

Before making the test, thoroughly clean the kettle to be tested and check the top edge to see that it is level and smooth.

To make the test, remove the scoop from balance and place the test

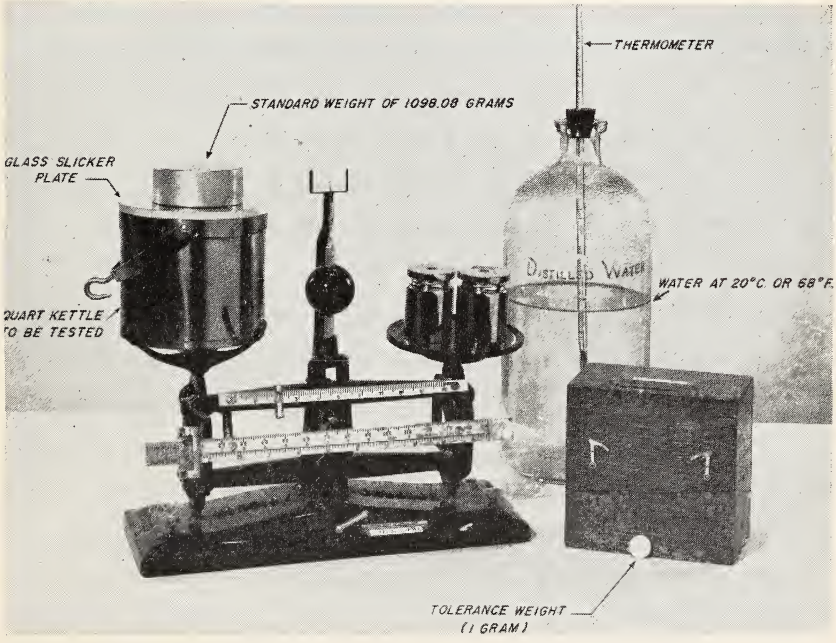

FIGURE 4.—Apparatus required for determining the accuracy of the quart-sized kettle. The standard weight shown on top of the glass slicker plate over the test kettle is equal in weight (1,098.08 grams) to 1 quart of water at 20° C. (68° F.).

kettle, glass plate, and standard weight on scoop bracket and bring the scale to exact balance by means of weights and sliding poise.

Remove kettle, glass plate, and standard weight without disturbing the weights or counterpoise. Place the kettle on the center of a towel. Fill it to overflowing with distilled water at a temperature of approximately 20° C. or 68° F. Eliminate all air bubbles from the inside of the kettle. Slide glass plate on top of kettle to remove excess water, leaving the kettle exactly level full with no air bubbles under the plate. Wipe off all moisture on outside of kettle with towel.

Carefully place kettle filled with water and covered with the glass plate on the scoop bracket of balance without disturbing weights previously set. Release the arrest or damper and allow the pointer on balance to come to rest. If the kettle and weights are in exact balance when the pointer stops oscillating, the capacity of the kettle is correct. If the pointer comes to rest at any position other than the center, place the 1-gram weight (tolerance weight) on the light side of the balance. If the tolerance weight is sufficient to swing the pointer to or across the center mark, the error in kettle capacity is within the allowable tolerance and the kettle may be used. But should the tolerance weight be insufficient to swing the pointer to the center of its arc, or bring the scale to balance, the error in the kettle capacity exceeds the allowable tolerance and the kettle should not be used in making official tests.

To insure a correct test, it is, of course, essential that the balance used in making the test be sufficiently sensitive to indicate a change in the pointer or beam reading when the tolerance weight is added to or taken from either arm of the loaded balance.

Method of Determining Accuracy of Beam and Sensitiveness of Balance

Before attempting to check the accuracy of the beam, the tester shoud be leveled either with a spirit level or by the mounted bubble device. This is done by means of the leveling screws. The pointer should be in the center of the trig loop when the empty kettle is on the beam and the counterpoises are at zero. This is accomplished by adjusting the balancing weight.

There are two methods of checking the accuracy of the beam graduations. In the more simple and direct method a special set of seven accurate testing weights is used, whereas in the other method an ordinary set of metric weights is used (fig. 5).

The seven special weights illustrated in figure 5 are marked to represent the following number of pounds per bushel: 60, 50, 40, 30, 20, 10, and 5. Each weight actually weighs one thirty-second of its marked value. To test the beam, place any weight or combination of weights, within the range of the beam graduations, in the kettle and bring the beam to balance by means of the counterpoise. The combined readings of the counterpoises should then equal the combined represented weights in the kettle: and the difference between the weight represented in the kettle and on the beams, if any, is the error of the beam.

It is essential in making correct weight-per-bushel tests, that the beam not only indicate an apparently correct reading when a given weight is placed in the test kettle but that the balance be sensitive to

FIGURE 5.—Special weights used in determining the accuracy of the beam in the weight-per-bushel testing apparatus. In making the test, these weights are placed in the test kettle.

within one-tenth of a pound per bushel. That is, the balance should be sufficiently sensitive to move from the center position to either the top or the bottom of the trig loop whenever the poise on the beam is shifted one-tenth pound under or over the balanced position.

In testing the beam by the second method, an accurate set of ordinary metric weights, comprising weights from 1,000 grams to 0.1 gram, is used. However, if 0.1-gram weights are not available, 1-gram weights may be used to check to within one-tenth of a pound per bushel.

The table of equivalents (table 2) has been prepared to facilitate the use of metric weights for checking beams.

HOW TO USE THE TABLE OF EQUIVALENTS

It must be remembered that the test weight per bushel in the table is shown on the beam of the tester, and that the equivalent grams per quart in the table are to be placed in the kettle.

The figures given in the table under the heading "Gm." measure the number of grams per quart and the figures given under "T. W." the test weight per bushel on the basis of the grams per quart.

WINCHESTER AND IMPERIAL BUSHEL—TEST WEIGHT-CONVERSION FACTORS

The test weight per bushel specified in the official grain standards of the United States is based on the Winchester or United States bushel, which has a capacity of 2,150.42 cubic inches. The test weight per bushel specified in the Canadian grain standards is based on the Imperial or British bushel, which has a capacity of 2,219.36 cubic inches. The Imperial bushel is 68.94 cubic inches larger than the Winchester bushel. To convert the test weight per bushel from the basis of Winchester bushel to the basis of Imperial bushel, multiply test weight per bushel by 1.032. To convert the test weight per bushel from the basis of Imperial bushel to the basis of Winchester bushel, multiply the test weight per bushel by 0.969.

TABLE 2.—*Conversion table showing the number of grams per quart to the test weight per bushel*

200				300				400				500			
Gm.	T.W.	Gm.	T.W.	Gm.	T.W.	Gm.	T.W.	Gm.	T.W.	Gm.	T.W.	Gm.	T.W.	Gm.	T.W.
200	14. 1	250	17. 6	300	21. 2	350	24. 7	400	28. 2	450	31. 7	500	35. 3	550	38. 8
201	14. 2	251	17. 7	301	21. 2	351	24. 8	401	28. 3	451	31. 8	501	35. 3	551	38. 9
202	14. 2	252	17. 8	302	21. 3	352	24. 8	402	28. 4	452	31. 9	502	35. 4	552	38. 9
203	14. 3	253	17. 8	303	21. 4	353	24. 9	403	28. 4	453	31. 9	503	35. 5	553	39. 0
204	14. 4	254	17. 9	304	21. 4	354	25. 0	404	28. 5	454	32. 0	504	35. 5	554	39. 1
205	14. 5	255	18. 0	305	21. 5	355	25. 0	405	28. 6	455	32. 1	505	35. 6	555	39. 1
206	14. 5	256	18. 1	306	21. 6	356	25. 1	406	28. 6	456	32. 2	506	35. 7	556	39. 2
207	14. 6	257	18. 1	307	21. 6	357	25. 2	407	28. 7	457	32. 2	507	35. 8	557	39. 3
208	14. 7	258	18. 2	308	21. 7	358	25. 2	408	28. 8	458	32. 3	508	35. 8	558	39. 4
209	14. 7	259	18. 3	309	21. 8	359	25. 3	409	28. 8	459	32. 4	509	35. 9	559	39. 4
210	14. 8	260	18. 3	310	21. 9	360	25. 4	410	28. 9	460	32. 4	510	36. 0	560	39. 5
211	14. 9	261	18. 4	311	21. 9	361	25. 5	411	29. 0	461	32. 5	511	36. 0	561	39. 6
212	14. 9	262	18. 5	312	22. 0	362	25. 5	412	29. 1	462	32. 6	512	36. 1	562	39. 6
213	15. 0	263	18. 5	313	22. 1	363	25. 6	413	29. 1	463	32. 7	513	36. 2	563	39. 7
214	15. 1	264	18. 6	314	22. 1	364	25. 7	414	29. 2	464	32. 7	514	36. 3	564	39. 8
215	15. 2	265	18. 7	315	22. 2	365	25. 7	415	29. 3	465	32. 8	515	36. 3	565	39. 8
216	15. 2	266	18. 8	316	22. 3	366	25. 8	416	29. 3	466	32. 9	516	36. 4	566	39. 9
217	15. 3	267	18. 8	317	22. 4	367	25. 9	417	29. 4	467	32. 9	517	36. 5	567	40. 0
218	15. 4	268	18. 9	318	22. 4	368	26. 0	418	29. 5	468	33. 0	518	36. 5	568	40. 1
219	15. 4	269	19. 0	319	22. 5	369	26. 0	419	29. 5	469	33. 1	519	36. 6	569	40. 1
220	15. 5	270	19. 0	320	22. 6	370	26. 1	420	29. 6	470	33. 1	520	36. 7	570	40. 2
221	15. 6	271	19. 1	321	22. 6	371	26. 2	421	29. 7	471	33. 2	521	36. 7	571	40. 3
222	15. 7	272	19. 2	322	22. 7	372	26. 2	422	29. 8	472	33. 3	522	36. 8	572	40. 3
223	15. 7	273	19. 2	323	22. 8	373	26. 3	423	29. 8	473	33. 4	523	36. 9	573	40. 4
224	15. 8	274	19. 3	324	22. 8	374	26. 4	424	29. 9	474	33. 4	524	37. 0	574	40. 5
225	15. 9	275	19. 4	325	22. 9	375	26. 4	425	30. 0	475	33. 5	525	37. 0	575	40. 6
226	15. 9	276	19. 5	326	23. 0	376	26. 5	426	30. 0	476	33. 6	526	37. 1	576	40. 6
227	16. 0	277	19. 5	327	23. 1	377	26. 6	427	30. 1	477	33. 6	527	37. 2	577	40. 7
228	16. 1	278	19. 6	328	23. 1	378	26. 7	428	30. 2	478	33. 7	528	37. 2	578	40. 8
229	16. 1	279	19. 7	329	23. 2	379	26. 7	429	30. 3	479	33. 8	529	37. 3	579	40. 8
230	16. 2	280	19. 7	330	23. 3	380	26. 8	430	30. 3	480	33. 9	530	37. 4	580	40. 9
231	16. 3	281	19. 8	331	23. 3	381	26. 9	431	30. 4	481	33. 9	531	37. 5	581	41. 0
232	16. 4	282	19. 9	332	23. 4	382	26. 9	432	30. 5	482	34. 0	532	37. 5	582	41. 0
233	16. 4	283	20. 0	333	23. 5	383	27. 0	433	30. 5	483	34. 1	533	37. 6	583	41. 1
234	16. 5	284	20. 0	334	23. 6	384	27. 1	434	30. 6	484	34. 1	534	37. 7	584	41. 2
235	16. 6	285	20. 1	335	23. 6	385	27. 2	435	30. 7	485	34. 2	535	37. 7	585	41. 3
236	16. 6	286	20. 2	336	23. 7	386	27. 2	436	30. 7	486	34. 3	536	37. 8	586	41. 3
237	16. 7	287	20. 2	337	23. 8	387	27. 3	437	30. 8	487	34. 3	537	37. 9	587	41. 4
238	16. 8	288	20. 3	338	23. 8	388	27. 4	438	30. 9	488	34. 4	538	37. 9	588	41. 5
239	16. 9	289	20. 4	339	23. 9	389	27. 4	439	31. 0	489	34. 5	539	38. 0	589	41. 5
240	16. 9	290	20. 4	340	24. 0	390	27. 5	440	31. 0	490	34. 6	540	38. 1	590	41. 6
241	17. 0	291	20. 5	341	24. 0	391	27. 6	441	31. 1	491	34. 6	541	38. 2	591	41. 7
242	17. 1	292	20. 6	342	24. 1	392	27. 6	442	31. 2	492	34. 7	542	38. 2	592	41. 8
243	17. 1	293	20. 7	343	24. 2	393	27. 7	443	31. 2	493	34. 8	543	38. 3	593	41. 8
244	17. 2	294	20. 7	344	24. 3	394	27. 8	444	31. 3	494	34. 8	544	38. 4	594	41. 9
245	17. 3	295	20. 8	345	24. 3	395	27. 9	445	31. 4	495	34. 9	545	38. 4	595	42. 0
246	17. 3	296	20. 9	346	24. 4	396	27. 9	446	31. 5	496	35. 0	546	38. 5	596	42. 0
247	17. 4	297	20. 9	347	24. 5	397	28. 0	447	31. 5	497	35. 1	547	38. 6	597	42. 1
248	17. 5	298	21. 0	348	24. 5	398	28. 1	448	31. 6	498	35. 1	548	38. 7	598	42. 2
249	17. 6	299	21. 1	349	24. 6	399	28. 1	449	31. 7	499	35. 2	549	38. 7	599	42. 2

TABLE 2.—*Conversion table showing the number of grams per quart to the test weight per bushel*—Continued

600				700				800				900	
Gm.	T. W.	Gm.	T. W.	Gm.	T. W.	Gm.	T. W.	Gm.	T. W.	Gm.	T. W.	Gm.	T. W.
600	42. 3	650	45. 8	700	49. 4	750	52. 9	800	56. 4	850	60. 0	900	63. 5
601	42. 4	651	45. 9	701	49. 4	751	53. 0	801	56. 5	851	60. 0	901	63. 6
602	42. 5	652	46. 0	702	49. 5	752	53. 0	802	56. 6	852	60. 1	902	63. 6
603	42. 5	653	46. 1	703	49. 6	753	53. 1	803	56. 6	853	60. 2	903	63. 7
604	42. 6	654	46. 1	704	49. 7	754	53. 2	804	56. 7	854	60. 2	904	63. 8
605	42. 7	655	46. 2	705	49. 7	755	53. 3	805	56. 8	855	60. 3	905	63. 8
606	42. 7	656	46. 3	706	49. 8	756	53. 3	806	56. 9	856	60. 4	906	63. 9
607	42. 8	657	46. 3	707	49. 9	757	53. 4	807	56. 9	857	60. 4	907	64. 0
608	42. 9	658	46. 4	708	49. 9	758	53. 5	808	57. 0	858	60. 5	908	64. 0
609	43. 0	659	46. 5	709	50. 0	759	53. 5	809	57. 1	859	60. 6	909	64. 1
610	43. 0	660	46. 6	710	50. 1	760	53. 6	810	57. 1	860	60. 7	910	64. 2
611	43. 1	661	46. 6	711	50. 1	761	53. 7	811	57. 2	861	60. 7	911	64. 3
612	43. 2	662	46. 7	712	50. 2	762	53. 7	812	57. 3	862	60. 8	912	64. 3
613	43. 2	663	46. 8	713	50. 3	763	53. 8	813	57. 3	863	60. 9	913	64. 4
614	43. 3	664	46. 8	714	50. 4	764	53. 9	814	57. 4	864	60. 9	914	64. 5
615	43. 4	665	46. 9	715	50. 4	765	54. 0	815	57. 5	865	61. 0	915	64. 5
616	43. 4	666	47. 0	716	50. 5	766	54. 0	816	57. 6	866	61. 1	916	64. 6
617	43. 5	667	47. 0	717	50. 6	767	54. 1	817	57. 6	867	61. 2	917	64. 7
618	43. 6	668	47. 1	718	50. 6	768	54. 2	818	57. 7	868	61. 2	918	64. 8
619	43. 7	669	47. 2	719	50. 7	769	54. 2	819	57. 8	869	61. 3	919	64. 8
620	43. 7	670	47. 3	720	50. 8	770	54. 3	820	57. 8	870	61. 4	920	64. 9
621	43. 8	671	47. 3	721	50. 9	771	54. 4	821	57. 9	871	61. 4	921	65. 0
622	43. 9	672	47. 4	722	50. 9	772	54. 5	822	58. 0	872	61. 5	922	65. 0
623	43. 9	673	47. 5	723	51. 0	773	54. 5	823	58. 1	873	61. 6	----	-----
624	44. 0	674	47. 5	724	51. 1	774	54. 6	824	58. 1	874	61. 6	----	-----
625	44. 1	675	47. 6	725	51. 1	775	54. 7	825	58. 2	875	61. 7	----	-----
626	44. 2	676	47. 7	726	51. 2	776	54. 7	826	58. 3	876	61. 8	----	-----
627	44. 2	677	47. 8	727	51. 3	777	54. 8	827	58. 3	877	61. 9	----	-----
628	44. 3	678	47. 8	728	51. 3	778	54. 9	828	58. 4	878	61. 9	----	-----
629	44. 4	679	47. 9	729	51. 4	779	54. 9	829	58. 5	879	62. 0	----	-----
630	44. 4	680	48. 0	730	51. 5	780	55. 0	830	58. 5	880	62. 1	----	-----
631	44. 5	681	48. 0	731	51. 6	781	55. 1	831	58. 6	881	62. 1	----	-----
632	44. 6	682	48. 1	732	51. 6	782	55. 2	832	58. 7	882	62. 2	----	-----
633	44. 6	683	48. 2	733	51. 7	783	55. 2	833	58. 8	883	62. 3	----	-----
634	44. 7	684	48. 2	734	51. 8	784	55. 3	834	58. 8	884	62. 4	----	-----
635	44. 8	685	48. 3	735	51. 8	785	55. 4	835	58. 9	885	62. 4	----	-----
636	44. 9	686	48. 4	736	51. 9	786	55. 4	836	59. 0	886	62. 5	----	-----
637	44. 9	687	48. 5	737	52. 0	787	55. 5	837	59. 0	887	62. 6	----	-----
638	45. 0	688	48. 5	738	52. 1	788	55. 6	838	59. 1	888	62. 6	----	-----
639	45. 1	689	48. 6	739	52. 1	789	55. 7	839	59. 2	889	62. 7	----	-----
640	45. 1	690	48. 7	740	52. 2	790	55. 7	840	59. 3	890	62. 8	----	-----
641	45. 2	691	48. 7	741	52. 3	791	55. 8	841	59. 3	891	62. 8	----	-----
642	45. 3	692	48. 8	742	52. 3	792	55. 9	842	59. 4	892	62. 9	----	-----
643	45. 4	693	48. 9	743	52. 4	793	55. 9	843	59. 5	893	63. 0	----	-----
644	45. 4	694	49. 0	744	52. 5	794	56. 0	844	59. 5	894	63. 1	----	-----
645	45. 5	695	49. 0	745	52. 5	795	56. 1	845	59. 6	895	63. 1	----	-----
646	45. 6	696	49. 1	746	52. 6	796	56. 1	846	59. 7	896	63. 2	----	-----
647	45. 6	697	49. 2	747	52. 7	797	56. 2	847	59. 7	897	63. 3	----	-----
648	45. 7	698	49. 2	748	52. 8	798	56. 3	848	59. 8	898	63. 3	----	-----
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